



GAS ANALYZER Mod. INFRAGAS-291 / HF



S E R V I C E M A N U A L

Edition: May 1998. Vers. 1.19
ASSEMBLAD - Technical office - Automotive Division
Master file: pc-c:\winword\dm94\291\R291gb12.doc



INDEX

1	DESCRIPTION	page	4
1.1	General specifications	"	4
1.2	Keyboard	"	5
1.3	Display and lamps	"	6
1.4	Printer	"	8
1.5	Standard accessories	"	8
1.6	Rear panel	"	9
1.7	Optional accessories	"	9
2	DESCRIPTION OF OPERATIONS	page	10
2.1	Installation procedure	"	10
2.2	Powering up the instrument	"	10
2.3	Use of the instrument	"	10
2.4	Calibration using gas bottle	"	11
2.5	Oxygen transducer replacement	"	11
3	PERFORMING A TEST	page	12
3.1	Standard test	"	12
3.2	Cares and notes	"	14
4	REAL-TIME CLOCK SETUP	page	16
5	STANDARD GAS CALIBRATION	page	17
5.1	<i>Periodic maintenance utility program</i>	"	17
5.2	<i>P.E.F. factor setting</i>	"	18 <== (###)
5.3	<i>Factory setting data display</i>	"	18
5.4	<i>Workshop customization</i>	"	19
5.5	<i>Customization data display</i>	"	19
5.6	<i>Calibration bottle certified data</i>	"	19 <== (###)
5.7	<i>Current concentration of bottle</i>	"	19
5.8	<i>Date & time setting</i>	"	19
5.9	<i>Current analyzer date & time display</i>	"	19
5.10	<i>Automatic gas calibration procedure</i>	"	20 <== (###)
5.11	<i>Temperature and pressure calibration</i>	"	21 <== (###)
5.12	<i>Reinitialize the analyzer</i>	"	21 <== (###)
5.13	<i>Analog channels voltage levels</i>	"	21
5.14	<i>Warm reset</i>	"	22
5.15	<i>Back to dos</i>	"	22
6	OPERATION AVAILABLE FROM KEYBOARD	page	23
6-1	Function enabling/disabling using keyboard	"	23
6-1-1	Skip Warm-up phase	"	23 <== (###)
6-1-2	Removing customization from the printer test report	"	23 <== (###)

6-1-3 Modifying P.E.F. value	“ 23 <== (###)
6-2 Normal operation (routine)	“ 24
6-2-1 Updating the clock/Calendar	“ 24
6-2-2 Select the right fuel	“ 24

6-3 Gas calibration using keyboard	“ 24 <== (###)
6-3-1 Calibration from keyboard using Gas Bottle	“ 25 <== (###)

7 TECHNICAL DATA	page 26
8 TROUBLESHOOTING	page 28
9 RESIDUAL HC TEST	page 33
10 AIRTIGHT SEAL TEST	page 33

(*) = OPTIONAL

Note: **(###)** the meaning of this mark it's: OPERATION ACCESSIBLE AT THE AUTHORIZED SERVICE ONLY and it's necessary to know the Password to entry. This operations are **described in the Service Manual** only.

Password: GHZGCR

1 DESCRIPTION

Infragas 291 is a self-calibrating, multifunctional infrared exhaust gas analyzer, with microprocessor based electronic circuitry.

1.1 GENERAL SPECIFICATIONS

- 1) CO, CO₂ and HC measurements based upon a NDIR method. HC range is 5000 ppm wide, in order to allow a quantitative evaluation of the performance of each cylinder. A "corrected" value of CO (see Chapter 3) is available on the print out.
- 2) O₂ measurement (*) performed using an electrochemical transducer provided on the rear panel of the instrument.
- 3) RPM measurement performed using the RPM Inductive Probe to be connected with one of the cylinders and has a 2/4 stroke selection.
- 4) Ambient Pressure measurement (PRESS mb) based upon a specific pressure transducer provided inside the instrument.
- 5) Ambient (AMB °C) and Oil Temperature (OIL °C) measurements performed using 2 separate temperature transducers provided one in the temperature probe (*) and the other inside the instrument.
- 6) Lambda and Air Fuel Ratio (AFR) computations obtained from gas measurement to test car manufacturer spec's (see Chapter 3).
- 7) Real-Time Clock-Calendar with battery backup allowing a data retention period of 5 days (guaranteed). A special function is provided to update the Real-Time Clock (see Chapter 4).
- 8) Automatic Condensate Drainage with message on display and automatic stop of gas suction. However, condensate may be manually emptied by depressing the drainage valve pushbutton below the condensate filter.
- 9) Green high-efficiency LED display to improve brightness.
- 10) 24 column Impact Printer to report all data measured (both displayed or not). Printed report may also be customized (*) with the Workshop Data.
- 11) Functional 5-keys Membrane Keypad for a good protection against dust and oil. Two red LED lamps monitor power on (ON) and pump on (PUMP).
- 12) Green high-efficiency LED lamps to monitor 4S / 2S selection, measurement selected on the FUNCTION display, power on and pump on. Besides, power on led blinks in case of voltage supply out of limits provided (220 Vac +/- 15 %).

- 13) Gas filtering devices (condensate filter and particle filter) provided externally on the rear panel for a quick maintenance.
- 14) Error and Special Operating condition messages on display to signal the occurrence of situations like flow missing (Err1) and condensate drainage (Con).
- 15) Self-calibration feature (using MEAS key) with "Cal" message on display and automatic switch to gas suction at the end of this stage. Self-calibration does not require removal of the hose from car exhaust pipe.
- 16) Standard RS-232 Serial Interface for future expansions for data processing equipments and for other external equipments.

1.2 KEYBOARD

Infragas 291 keyboard is composed of 5 keys each corresponding to a specific function.

- 1) MEAS (MEASURE) key : causes the instrument to start a new measurement by initially performing a self-calibration stage. At the beginning the instrument switches its internal valve to suck in ambient air. This stage requires approx. 30 sec. during which the message "Cal" appears on CO and CO2 displays and data on gas displays (including HC and O2) have no meaning. During this stage a new push of MEAS key causes a termination of measurement sequence. At the end of self-calibration stage the message "Cal" disappears and instrument automatically switches to suck in gases from the hose, thus keeping the suction pump on until the START / STOP key has been pressed or after about 10 minutes from this operation.
- 2) START / STOP key: causes the suction pump to switch off. Pump state is displayed by the pump lamp placed beside the key. For restart the Pump is necessary to push the MEAS key.
- 3) 4S / 2S key: allows selection of RPM computation mode, related to the engine type (4-stroke or 2-stroke); the lighting of one of the two lamps placed beside RPM display indicates selection made (see also Cap. 6-2-2 for motor fuel selections).
- 4) FUNC key: allows selection of measurement to be displayed on FUNCTION display. Available measurements are:
 - Engine Oil Temperature (OIL °C)
 - Ambient Temperature (AMB °C) the value displayed show the inside temperature
 - Ambient Pressure (PRESS mb)
 - Lambda value for many motor fuel (blinking O2 led and "L" on the rightmost digit)
 - Air / Fuel Ratio (blinking O2 led and "A" on the rightmost digit)

Each push of the FUNC key causes a switching of selection from top to bottom as indicated by the corresponding lamp placed beside.

Regardless of selection made on FUNCTION display, a printing will include every measurement performed by the instrument, even if not displayed.

- 5) PRINT key: performs the print out of all measured and / or computed data (both displayed or not) together with date and time and Workshop data (*) if provided. Lambda value is relative to different propellant. A CO corr. parameter (corrected CO value) is also printed (see Chapter 3).
If you need to have another report you must repeat the sequences: START/STOP ⇒ MEAS and after "Cal" time ⇒ PRINT when the display has a stable appearance.

1.3 DISPLAY AND LAMPS

INFRAGAS-291 / HF has on the front panel 5 displays and 6 led lamps; displays are splitted into 3 sets.

- 1) Infrared bench related displays : CO, CO2 and HC displays. This set is placed on the right upmost part of the panel; it constantly shows measured data except:
 - during warm-up time the CO display show the PEF value, CO2 show the writing "PEF", and the Function display show the Warm-up time remaning in minutes.
 - during self-calibration stage CO and CO2 displays have the "Cal" message on, while gas data (including HC and O2) are meaningless.
 - in case of an insufficient flow on gas path occurs, on CO CO2 and HC displays the message "Err1" appears. In this conditions gas measurement is inhibited.
 - in case of condensate excess, on CO and CO2 displays the message "Con" appears indicating that instrument has stopped suction and provides for automatic drainage. During this stage gas measurement is inhibited.
- 2) Auxiliary parameters displays; this set, placed on the left upmost part of the front panel, includes:
 - RPM display and 4S / 2S lamps indicating selection made by 4S / 2S key. RPM display continuously shows engine RPM whichever are instrument operating conditions (see also Cap. 6-2-2).

3) Auxiliary parameters displays; this set, placed on the left downmost part of the front panel, includes FUNCTION display and four selection lamps on the left showing one of the six available parameters selectable by FUNC key:

- Engine Oil Temperature
- Ambient Temperature
- Ambient Pressure
- Oxygen Concentration
- Lambda value
- Air / Fuel Ratio

FUNCTION display always shows the selected measure except in the following cases:

- O2 measurement: while self-calibrating ("Cal" message on CO and CO2 displays) or condensate draining ("Con" message on CO and CO2 displays) function data are meaningless;
- for every selection: in case of missing flow in pneumatic circuitry, FUNCTION display shows the "Err1" message and gas data are meaningless.

1.4 PRINTER

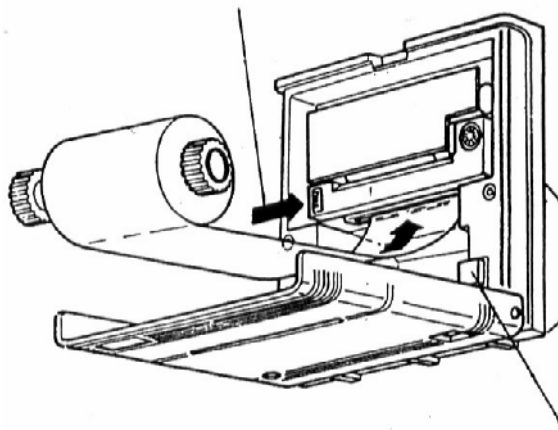
The instrument is equipped with a 24 column impact printer. Both paper roll and ink-ribbon cartridge are of easy and quick replacement, being accessible from the door provided on the front panel of the instrument.

Printer reports, whenever required, all the available parameters together with data and time and Workshop data (*) if provided. Whatever may be selected on FUNCTION display, all the auxiliary parameters are printed out.

Note

After one print report it is always necessary to perform a calibration pressing START/STOP key then MEAS key before to request another operation of PRINT.

Press to remove printer ribbon



Press to advance paper

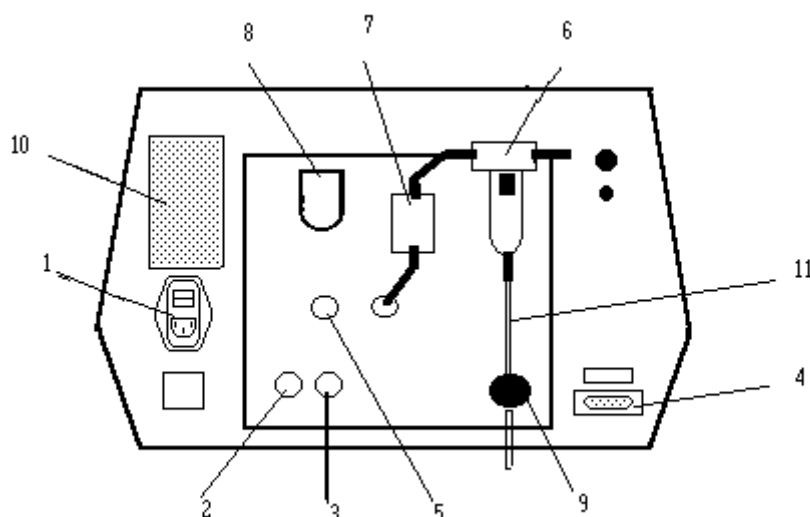
1.5 STANDARD ACCESSORIES

- 1) 5,80 m. hose with gas takeup tip.
- 2) RPM probe.
- 3) Line power cord.
- 4) This manual.

1.6 REAR PANEL

On INFRAGAS-291 / HF rear panel the following devices are displaced:

- 1) Power supply socket and switch with fuse holder.
- 2) RPM probe connector.
- 3) Temperature probe connector.
- 4) Standard RS-232 serial interface connector.
- 5) Gas outlet.
- 6) Condensate filter with gas inlet junction and a connection to the drainage valve.
- 7) Particles filter.
- 8) Oxygen transducer holder with cover (*).
- 9) Drainage valve.
- 10) Identification plate.
- 11) Drainage pipe



1.7 OPTIONAL ACCESSORIES

- 1) Oil Temperature probe.
- 2) Infrared remote control.
- 3) Trolley.
- 4) Personalized print out (see Cap. 5-4 Workshop customization)
- 5) Oxygen transducer (for INFRAGAS-291 / HF which has not that sensor but it is possible to install it later. When Oxygen trasducer it is installed or replaced you must have gas calibration).

2 DESCRIPTION OF OPERATIONS

2.1 INSTALLATION PROCEDURE

Remove the instruments from its package, install it on a trolley and connect accessories as follows:

- connect RPM inductive probe to the RPM connector placed on rear panel;
- connect gas hose to the gas takeup tip being sure that the arrow on the filter placed on the hose is in the direction of gas flow, then connect the other side of the hose to the condensate filter on rear panel;
- connect temperature probe (*), if provided, to the rear panel connector;

Leave accessories always connected to the instrument, even if not used, to speed up operations.

Warning:

once unpacked, the instrument may have internal NiCd battery discharged; this means that real-time clock has no date / time or a date / time value incorrect. In this case the instrument must be connected to power and left powered on continuously for 24 hours to insure full charge to internal NiCd battery. Then follow instructions to setup real-time clock (see Chapter 4).

2.2 POWERING UP THE INSTRUMENTS

Connect the line power cord to the instrument and switch it on; the instrument starts printing the preamble. Wait for 15 min. (15 min it is the max. time) of warm-up time before to start measurements on gases. The "Function" display show the warm-up time remaining.

Warm-up procedure doesn't stop until the analyzer reach the requested temperature.

After this procedure the analyzer automatically performs a self-calibration then it will pass to the exhaustion stage.

2.3 USE OF THE INSTRUMENT

1) After switching on, the instrument automatically sets to the following conditions:

- 4-stroke engine type (RPM selection)
During the "Cal" procedure you can select the engine fuel (see 6--2-2)
- O2 display (FUNCTION selection)

- 2) Insert takeup tip into the motorcar exhaust pipe, connect RPM probe to one of the spark plugs cables and insert the temperature probe, if provided, into the oil measuring rod receptacle.
- 3) After warm-up, instrument is ready to work; user may select, using FUNC key, one of the auxiliary parameters available on FUNCTION display; moreover the engine type may be selected using 4S / 2S key for RPM measurement.
- 4) For gas measurement user presses MEAS key causing a self-calibration, after which analyzer passes to a gas exhaustion stage. During this period the instrument, if gas is present, periodically performs calibrating procedures (every 10 min.), while automatically turns the pump off in case of gas lack for at least 10 min.
- 5) Operator may decide everytime to print out data using PRINT key, provided that pump is on.
- 6) Once measurement has been completed, or whenever the operator wants, he may decide to terminate gas exhaustion pressing START / STOP key. However, if no action is taken the instrument automatically turns the pump off after approx. 10 min. of continuous operation, to preserve the pump from an useless stress.

2.4 CALIBRATION USING GAS BOTTLE

Manufacturer recommends a calibration with certified gas bottle (see Chapter 5) every six months. In some countries legislation defines specific rules. Please contact our distributor for this periodical service activity.

2.5 OXYGEN TRANSDUCER REPLACEMENT

The oxygen transducer (*) life-time is 12 months (minimum) from the date of delivery. Please contact our distributor for periodical replacement

3 PERFORMING A TEST

3.1 STANDARD TEST

Here the suggested procedure to test an engine is explained. It is also shown that INFRAGAS-291 / HF is a complete instrument to test in an exhaustive way the combustion process and all the related devices of a car engine.

- A) Install and switch on the instrument as explained in the preceding chapters.
- B) Insert the gas takeup tip into the exhaust pipe.
- C) Start the car engine and connect the RPM probe to one of the spark plugs cables, being sure that the arrow on the body of the clamp is in the direction of cylinder. Then select the engine type using 4S / 2S key.
- D) Insert the temperature probe into the oil rod receptacle.
- E) Using FUNC key select ambient temperature (AMB °C) and verify that its value is in the range 5÷40 °C.
- F) Using FUNC key select ambient pressure (PRESS mb) and verify that its value is in the range 850÷1050 mbar.
- G) Using FUNC key select oil temperature and wait until this parameter has reached 80 °C to be sure that engine has been properly warmed up. In case of lower temperature keep the engine at about 2000 RPM until this temperature is reached.
- H) When the proper oil temperature has been reached verify that RPM value is in the range declared by the car manufacturer. In case of missing declaration RPM must not exceed 1000 RPM.
- I) If the 15 min. warm-up time is over, and Pump is OFF, press MEAS key and start sampling exhaust gases (after a preliminary automatic self-calibration) until gas readings are stable.
- J) Print data as a report of measurements done. Note that printer gives an additional parameter: the corrected value of CO (CO corr). This parameter is helpful in case of leaks in the car exhaust pipe. Expression for CO corr is the following:

$$[\text{CO}] \text{ corr \%} = (\#) \times [\text{CO\%}] / ([\text{CO\%}] + [\text{CO2\%}])$$

where (#) it is:

- = 15 for engines supplied with gasoline
- = 12 for engines supplied with CH₄
- = 14 for engines supplied with GPL

if CO+CO₂ is lower to 15, otherwise CO corr = CO

K) Compare following data with the corresponding ones declared by the car manufacturer, or with expected values:

- CO
- CO₂
- HC
- O₂
- Lambda
- AFR

AFR (Air Fuel Ratio) is a parameter computed by INFRAGAS-291 / HF software.

Lambda is a parameter computed as follows:

$$\text{Lambda} = \text{Num} / \text{Den}$$

where:

Num:

$$21 \times [[\text{CO}_2] + ([\text{CO}]/2) + [\text{O}_2] + ((\text{HCV}/4) \times 3,5 / (3,5 + [\text{CO}] / [\text{CO}_2]) - 0.00877 \times ([\text{CO}_2] + [\text{CO}])]$$

Den:

$$[21 + 0.5628 \times (([\text{CO}]/[\text{CO}_2]) / 3,5 + ([\text{CO}] / [\text{CO}_2]))] \times [1 + \text{HCV}/4 - 0,01754/2] \times [\text{CO}_2] + [\text{CO}] + [\text{HC}] \times 6 \times 10^{-4}]$$

where HCV = 1.85 for engine supplied with Gasoline
 = 2.57 for engine supplied with GPL
 = 4 for engine supplied with Methane

With [CO], [CO₂] e [O₂] = % in vol. and HC = ppm in vol.

If out of range data are measured, proceed with proper repairs and adjustments on the motorcar.

L) After this work, print a report of repairs and adjustments done.

3.2 CARES AND NOTES

- During tests be sure that RPM probe cord is not passing close to the other cylinders or to the coil to avoid electronic noises.
- Be sure that arrow on the clamp of RPM probe is in the right direction (to the cylinder).
- Sometimes RPM probe cannot measure RPM. It depends on very special kind of plug cords strongly shielded. In such cases write manually RPM on printed report as read from the engine speed indicator.
- Before every test, verify that condensate filter is not full of water to avoid an unpredictable stop of the test itself for a possible automatic condensate drainage. Press the drainage valve white button to manually empty the condensate filter.
- The internal porous septum of condensate filter must be cleaned periodically to avoid flow missing. To do this first be sure that pump is off, then remove the small silicone hose from the drainage valve pinchcock and unscrew carefully but firmly the plastic glass of filter; the internal septum can be removed by acting on the screw placed below it. The porous septum can be cleaned by bathing it with gasoline or trichloroethylene. After a while, blow in compressed air and put it back in its place. Finally screw the plastic glass, being sure that the o-ring is well positioned, and put the small silicone hose in the valve pinchcock.
- Replace periodically the particle filter.
- If the "Err1" message appears on FUNCTION display verify that:
 - the gas tip and the hose are not blocked up or full of condensate;
 - the condensate filter is not full;
 - the particle filter is not damaged or blocked up;
 - the gas exhaust of instrument is not blocked up. Note that in this case, after having removed the block, it takes about 5 min. to restore O₂ measurement stability because of possible pneumatic stress of Oxygen sensor.
- It is advisable to remove, almost every day, water from gas hose by blowing in compressed air in the direction of particle filter arrow (from the tip to the instrument) obviously after having removed the hose from the instrument.
- When oil temperature is below 45 °C the "or" message (out of range) is displayed on FUNCTION display, if oil temp. is selected.
- The "or" message may also appear when Lambda and AFR are selected on FUNCTION display. It means that these parameters are out of range (see ranges in Chapter 6).

- When ambient temperature is below 0 °C or above 45 °C the "or" message is displayed on FUNCTION display if amb. temp. is selected.
- When date / time values are not correct (out of range), date and time are not printed by the instrument. A date / time setup procedure must be performed (see Chapter 4).
- When date / time values are lost due to power absence for a long period, perform setup procedure and then keep instrument on for at least 24 hours to completely charge internal NiCd battery.
- The "ON" led on front panel blinks when power supply is out of its range (+ 10, - 15 %).

4 REAL-TIME CLOCK SETUP (Manual adj)

This procedure is useful everytime a wrong date / time is printed due to a long period of power absence (more than 5 days).

Wrong data from real-time clock can be detected in the preamble after switching on.

- 1) Press FUNC key and PRINT key simultaneously. The instrument will display the "GiO" message on CO2 display (day setting) and a 2 digit number on CO display, indicating currently stored day. Act on 4S / 2S and PRINT keys respectively to increase and decrease current day value and then press FUNC key.
- 2) The instrument now shows the "MES" message on CO2 display (month setting) and a 2 digit number on CO display, indicating currently stored month. Act on 4S / 2S, PRINT and FUNC keys as described above.
- 3) The instrument now shows the "Ann" message on CO2 display (year setting) and a 2 digit number on CO display, indicating currently stored year. Act on 4S / 2S, PRINT and FUNC keys as described above.
- 4) The instrument now shows the "orE" message on CO2 display (hour setting) and a 2 digit number on CO display, indicating currently stored hour. Act on 4S / 2S, PRINT and FUNC keys as described above.
- 5) The instrument now shows the "Min" message on CO2 display (minute setting) and a 2 digit number on CO display, indicating currently stored minute. Act on 4S / 2S, PRINT and FUNC keys as described above.

After minutes setup, FUNC key pressure causes real-time clock setup termination and a return to normal run.

5 STANDARD GAS CALIBRATION

5.1 PERIODIC MAINTENANCE UTILITY PROGRAM

Some of the operations available on INFRAGAS-291 / HF are feasible from keyboard or remotely using a Personal Computer connected to the analyzer with a proper serial link wiring.

Other functions are instead possible only with a remote control, activating the "Periodic Maintenance Utility" program.

This program can be installed creating a directory named A291 on hard disk and then copying in it all the contents of the distributed floppy disk.

It is also possible to execute an automatic installation inserting the distributed floppy disk in its drive and keying in:

A:\INSTALL <enter> or C: md A291 <enter> and Copy a:*. * C:\A291 <enter>

After the installation it is possible to start the program going under the directory named A291 and then keying in:

A291 <enter>

An image described ahead and representing a choice menu will appear.

In the upper right part of the screen current date and time are displayed while in the middle the available functions can be selected using arrow keys (in the last line a brief description of currently selected option will appear).

Serial port configuration is performed pressing <F6> key and then a window allowing serial communication parameters insertion will be displayed.

INFRAGAS-291 / HF default setting is:

Speed : 1200 Baud

Bit : 8

Parity : None

Now each selectable menu option will be explained.

Note: **(###)** the meaning of this mark it's: OPERATION ACCESSIBLE AT THE AUTHORIZED SERVICE ONLY and it's necessary to know the Password to entry. This operations are **described in the Service Manual** only.

INFRARED 291/HF GAS ANALYZER**Periodic maintenance utility****ASSEMBLAD 06/04/95 10:50**

P.E.F. factor setting
Factory setting data display
Workshop customization
Customization data displaying
Calibration bottle certified data
Current concentration of bottle
Date & Time setting
Current analyzer Date & Time display
Automatic gas calibration procedure
Temperature and Pressure calibration
Reinitialize the analyzer
Analog channels voltage level
Warm reset
Back to DOS

5.2 P.E.F. FACTOR SETTING (###)

It is used to modify current P.E.F. (Propan/Hexane Factor).

It must be used only in the eventuality of a loss (for any reason) of the one recorded in factory during test. This situation would in fact cause errors in reading HC values.

Current P.E.F. is visible on CO display after INFRAGAS-291 / HF switching on.

After selection of this option a window asking for the input of a 3-digit number (representing new P.E.F. value x 1000) will appear.

5.3 FACTORY SETTING DATA DISPLAY

After the choice of this option factory data recorded in INFRAGAS-291 / HF are displayed in the following way:

- Serial number
- P.E.F.
- Version and firmware release

5.4 WORKSHOP CUSTOMIZATION

This option allows INFRAGAS-291 / HF customization input. Customization consists of 6 text lines (24 characters each) that will be printed on every ticket.

5.5 CUSTOMIZATION DATA DISPLAYING

This option allows INFRAGAS-291 / HF current customization display.

5.6 CALIBRATION BOTTLE CERTIFIED DATA (###)

Selection of this function allows transmission to INFRAGAS-291 / HF of certified bottle gas volumetric concentrations to be used for periodic gas calibration of the instrument.

Volumetric concentrations of CO e CO₂ must be input in % while those of HC (Propan) and Hexane in ppm (parts per million).

Hexane percentage, even if present, isn't used in gas calibration, so it is advisable to input the default value of 1000.

5.7 CURRENT CONCENTRATION OF BOTTLE

Selection of this option causes display of INFRAGAS-291 / HF recorded data relative to certified bottle gas volumetric concentrations. Analyzer will use these parameters during gas calibration procedure.

5.8 DATE & TIME SETTINGS

This function performs internal clock setting using Personal Computer current date and time, which are displayed in the upper right part of the screen with a green background.

5.9 CURRENT ANALYZER DATE & TIME DISPLAY

Choosing this option, INFRAGAS-291 / HF current date and time will be displayed on a screen window.

5.10 AUTOMATIC GAS CALIBRATION PROCEDURE (###)

Selection of this option will start instrument automatic gas calibration procedure.

Preliminary stage is performed connecting reference bottle with INFRAGAS-291 / HF exhausted gases input valve by means of a flexible pipe with an inside diameter of 5 mm and not longer than 2 m.

Typically, bottle gas must be brought to the instrument with a relative pressure of 0.1 bar and a flux of 1 litre / minute.

Bottle pressure-gauge mustn't indicate a pressure lower than 2 atm., otherwise it is necessary to replace the bottle.

Bottle includes a test certificate on which gas concentration values are carried. Be sure that such values are in accordance to the ones stored in INFRAGAS-291 / HF selecting "Current concentration of bottle", otherwise they must be modified selecting "Calibration certified bottle data".

Advised values for a good instrument setting are the following:

CO :	between 1.5 % and 4 %
CO2 :	between 9 % and 13 %
HC (Propan):	between 800 ppm e 2000 ppm

(everyone in Nitrogen).

At last, be sure that INFRAGAS-291 / HF is operative, that is having completed its initial heating stage.

Then it is necessary to perform a zero calibration pressing <MEAS> key and after its completion pump must be deactivated.

After these operations gas calibration can start selecting the corresponding option with <enter> and opening bottle cock.

After a stabilization stage of gas inside analyzer (depending on pipe length and bottle pressure, typically 20÷30 seconds) INFRAGAS-291 / HF buzzer rings to confirm self-calibration request and then it rings again to confirm self-calibration completion. Simultaneously, a successful message is displayed on the screen, together with the direction of turning off and removing the bottle.

Procedure has thus come to the end.

5.11 TEMPERATURE AND PRESSURE CALIBRATION (###)

This option allows calibration of barometric pressure and temperature internal sensors.

Sensors are calibrated during factory test so this operation is necessary only in case of replacement of one of them.

In order to perform this operation standard thermometer and barometer are necessary and their values will have to be input in the screen window appeared after selection of this option.

Standard thermometer must take temperature under stationary conditions, as close as possible to INFRAGAS-291 / HF temperature sensors.

5.12 REINITIALIZE THE ANALYZER (###)

This option must be used with care and only in case of absolute necessity because it implies INFRAGAS-291 / HF recorded data deletion and their replacement with the ones given by the manufacturer and recorded during factory test.

This option is necessary only when INFRAGAS-291 / HF shows a completely wrong behaviour or after replacement of some critical electronic components.

Because of the risks of this operations, before its execution it is necessary to input the password "ASSEMBLAD". After, a window with instrument serial number will be displayed. If there is more than one serial number it is possible to select the one of the instrument to be reinitialized using arrow keys and then pressing <enter>.

After a few seconds the operation will be completed and a confirmation message will be displayed.

Changes made will be manifest switching off and then on again INFRAGAS-291 / HF or simply selecting "Warm reset" option.

5.13 ANALOG CHANNELS VOLTAGE LEVEL

Selection of this option causes voltage display of all the analog channels in order to perform channels gain calibration.

This operation has already been executed in factory so it is necessary only after replacement of some critical electronic components.

Measurements are displayed in Volts and updated every second.

5.14 WARM RESET

This option performs INFRAGAS-291 / HF restart, like switching off and then on again the instrument, but without doing it.

After that INFRAGAS-291 / HF starts its heating initial stage, which will end quickly because in the meanwhile infrared emission hasn't been stopped.

5.15 BACK TO DOS

It allows program ending and the return to the operating system.

6 OPERATION AVAILABLE FROM KEYBOARD

Some the operations of service on INFRAGAS-291 / HF are feasible from Keyboard

6-1 FUNCTION ENABLING/DISABLING USING KEYBOARD

6-1-1 SKIP WARM-UP PHASE (###)

In order to skip the powering up initial 15 minutes of heating press simultaneously the PRINT+4S/2S keys within 3 seconds after powering up.

The count down display goes to '0' then after few seconds the analyzer starts its normal cycle performing an electrical calibration.

Use this option with care because subsequent gas reading could be unreliable if the camera was not working at its normal temperature.

Remember that during the initial 15 minutes of heating, the analyzer skip this phase itself if it found an acceptable level of thermal heating.

6-1-2 REMOVING CUSTOMIZATION FROM THE PRINTED TEST REPORT (###)

Workshop customization data can reside both in internal erasable EEPROM as in non erasable EPROM.

If erasable data are activated (via the serial link to an external PC running the "A291" program) they prevail over the non erasable data written in EPROM.

Pressing symultaneously FUNC + 4S/2S keys within about 10 seconds after powering up it is possible to inhibit data residents on erasable area; in this case on the test report the workshop customization data resident in non erasable area (EPROM) will be printed.

Such workshop customization is void (six blank line) as default.

This operation allow to restore the old customization or to change the customization data without using a PC but replacing the EPROM with a new one supplied by ASSEMBLAD containing new workshop customization data.

6-1-3 MODIFYING P.E.F. VALUE (###)

The right value of P.E.F. is registered by the manufacturer during the initial testing of the analyzer, so there's no need to change it later unless some special test made by specialized technical operators.

The P.E.F. value can be changed pressing simultaneously FUNC + START/STOP keys within 10 seconds after powering up.

6-2 NORMAL OPERATIONS (Routine)

6-2-1 UPDATING THE CLOCK/CALENDAR

New Date & Time can be updated using an external PC running the 'A291' program connected via the serial line.

If a PC can't be used press simultaneously the FUNC + PRINT keys.

The CO₂ display will show in turn Gio, Mes, Ann, Ore, Min as Day, Month, Year, Hours, Minutes and the CO display the current setting for the value involved.

The values shown in the CO display can be changed using the key 4S/2S to increase and the key PRINT to decrease them.

The key FUNC confirm the value shown then propose the next one in the shown CO₂ list.

6-2-2 SELECT THE RIGHT FUEL

For each vehicle test the right fuel must be selected in order to evaluate the values of LAMBDA and the CO corrected according to the existing laws.

The selection is possible during the phase of electrical autozeroing preceding each vehicle test. In this situation the string 'CAL' is written on both CO and CO₂ display and the RPM display show the actual selected fuel as:

bEn0 = Super-premium petrol

Met0 = Methane

GPL0 = Liquefied petroleum gas (LPG)

Cat0 = Unleaded gasoline

Press in this phase the key 4S/2S until the right kind of fuel is shown.

The selection made is active until a new one is issued.

At the powering up the fuel selected is the default one as 'bEn0'.

6-3 GAS CALIBRATION USING KEYBOARD (###)

Important

The gas calibration procedure can be executed by qualified personnel by means of external PC running the 'A291' program linked via the serial line.

It is also possible to activate the same procedure by the keyboard but this function is enabled/disabled during the factory test depending on which Country the analyzer must be used.

6-3-1 Calibration from keyboard using Gas bottle (###)

- a) Press FUNC key and MEAS key simultaneously.
The instrument will display current values of the gas concentration for the calibration bottle and show 'bott' in the FUNCTION display.

Be sure that values shown does match exactly the values written in the certified bottle.

If this is not the case adjust the values registered until an exact match is performed using the FUNC key to select the digit to modify (the blinking one) and PRINT key and 4S/2S key to increment/decrement the selected digit.

Procedure is aborted by the START/STOP key or after 15 seconds without any action on the keyboard.

- b) When the exact match is reached press the MEAS key to start the calibration procedure and then open the gas bottle.

The instrument will start doing an electrical autozeroing first followed, when the pump goes off, by the proper gas calibration emitting a first 'beep'.

If the bottle is still closed or perhaps disconnected a warning flashing message 'bott' will appear in the FUNCTION display and the instruments starts to emit a sustained 'beep' until the calibration is done or the key START/STOP is depressed.

- c) If the calibration procedure succeeds a second 'beep' is emitted and the instrument goes back to its normal functions.

Calibration data concerning the bottle concentration remains stored inside the instrument so, there's no need of multiple actions on the keyboard. Only two keys are requested to performe the gas calibration if periodically the same bottle is used.

If gas calibration is performed using single gas bottles instead of the ternary one, the above procedure must be repeated once for each gas, putting to 0.0 the concentration values of gases each time not involved.

7 TECHNICAL DATA

Ranges of measurements and display resolution:

	RANGE	RESOLUTION
CO	0 ÷ 9.99 vol %	0.01 %
CO ₂	0 ÷ 19.9 vol %	0.1 %
HC	0 ÷ 999 vol %	1 ppm
HC	1000 ÷ 5000 ppm	10 ppm
O ₂ (*)	0 ÷ 9.99 vol %	0.01 %
O ₂ (*)	10 ÷ 25 vol %	0.1 %
RPM	400 ÷ 9000 rpm	10 rpm
Oil Temp. (*)	45 ÷ 120 °C	0.1 °C
Amb. Temp. (*)	0 ÷ 100 °C	0.1 °C
Amb. Press.	850 ÷ 1050 mbar	1 mbar

Ranges and display resolutions of computed data:

	RANGE	RESOLUTION
CO corr.	0 ÷ 9.99 vol %	0.01 %
AFR	7.0 ÷ 23.0	0.1
Lambda	0.50 ÷ 1.50	0.01

Displays and leds:

5 high efficiency green led displays.
 led indicators for FUNCTION display selection.
 led indicators for 4S / 2S type of engine.
 Power on led indicator.
 Pump on led indicator.

Keyboard:

5 functional keys keypad.

Printer:

24 column impact printer with personalizable print out.

Serial interface:

Standard RS-232 serial interface for connections with future expansions or data processing equipments.

Other functions:

Flow missing warning message on display.
Automatic and manual condensate drainage.
Automatic self-calibration.
Voltage out of range indication.

Future developments:

The instrument has the possibility to add a further standard RS-232 serial interface. Moreover it is possible to update software to comply with future European or local laws.

Response time:

10 sec. (3 m sampling hose).

Warm-up time:

15 min. max.

Operating temperature:

5 ÷ 40 °C

Power supply:

220 Vac, 50 Hz with 0.5 A max absorption (110, 230, 240 Vac and/or 50, 60 Hz on request)

Dimensions:

480 x 300 x 650 mm

Weight:

20 Kg approx.

8 TROUBLESHOOTING

Ref.	Fault	Possible Cause or Remedy
1	The analyzer does not go on.	Remove the power supply cord. Open the door to the fuse box on the switch unit and replace the blown fuse.
2	When powered up all the the displays read zero and even the printer is off.	Switch off the analyzer, remove Int. Circ. MC146818A (RTC) from its base and reinsert it.
3	All the displays read zero with gas inside. The printer only prints the the initial message.	As above (the analyzer probably has an old version of the program)
4	All the displays read zero. The printer is operating normally.	Check voltage on the three analog channels as described in the service manual. The cause could be low infrared emissions. If this recurs, replace the infrared emitter and then carry out electric and gas calibrations.
5	Some of the displays show values close to the upper limit of the scale, such as CO=9.99 or CO ₂ =19.9, etc.	Check voltage on the three analog channels as described in the service manual. The cause could be a lack of infrared emissions. If this recurs, replace the infrared emitter and then carry out electric and gas calibrations.
6.	One or more displays remain at zero or close to the maximum value on the scale.	Check voltage on the three analog channels as described in the service manual. The problem may be due to a broken infrared receiver. If this recurs, replace the infrared receiver or the entire preamp board and then carry out electric and gas calibrations.
7	Values of CO, CO ₂ and HC shown of display are not stable during the time.	Check, make stronger or replace the electrical connection between the voltage regulator LM350K (installed directly on the chassis) and the screwed wire below the chassis. After that, check the electrical level of the three channels (CO, CO ₂ , HC). If needed adjust them then recalibrate the analyzer with the gas reference bottle.

- | | | |
|----|---|--|
| 8 | the same as above. | <p>Check if the clamp that hold the infrared emitter is strong. If not, tighten the nuts on the anchor plate.</p> <p>After that, check the electrical level of the three channels (CO, CO₂, HC). If needed adjust them then recalibrate the analyzer with the gas reference bottle.</p> |
| 9 | Oxygen levels are always high, even in the presence of other gases. | <p>Check the expiry date on the sensor (the mean life is 12 months).</p> |
| 10 | The printout does not show the date, or it shows the wrong date | <p>The clock lost its data because the analyzer was switched off for too long. Switch on the analyzer for at least 12 hours, reset the clock as described in the operator's manual.</p> |
| 11 | When the analyzer is switched on the PEF shown is not the same as stated. | <p>The analyzer has suffered an electric shock. Reinitialize using the disk supplied with the device. Check the service manual for the mode.</p> |
| 12 | Some values on the display are absurd. | <p>The analyzer has suffered an electric shock. Reinitialize using the disk supplied with the device. Check the service manual for the mode. Carry out electric and gas calibrations.</p> |
| 13 | The printer does not start when you press the PRINT key. | <p>Make sure the pump is on. Remember that only one printout is possible for each measure cycle.</p> |
| 14 | As above | <p>Press START/STOP then MEAS, at the end of the CAL phase check again with a PRINT command (some laws forbid consecutive printing of two results).</p> |
| 15 | The printer only issues part of the ticket, then it stops. | <p>If the analyzer is programmed for Cat0" catalyzed vehicles (unleaded fuel) the procedure is correct. Bring motor to the accelerated minimum, press PRINT again, the printer will complete the message.</p> |
| 16 | One or more displays read CON. | <p>The analyzer is draining condensate. Wait for the timer to run out. This device trips more frequently in cold temperatures</p> |

		Make sure that the condensate drains are always free and not blocked.
17	One or more displays read Err0 or Err1	<p>The analyzer shows a low flow of aspirated gases. Make sure that the gas inlet probe is free of condensate and has dry bends. Make sure that the paper pre-filter on the gas tube is not blocked or dirty. Make sure that the filter on the condensate separator is not dirty, if necessary remove, wash, dry and replace it.</p> <p>Make sure that the exhaust gas tube on the analyzer is free (sometimes microorganisms colonize this terminal part and block gas outlet). If the problem persists in spite of all the above checks, disconnect the power supply and the pressure switch. If the problem still persists, check the circuit board, or try to replace the pressure switch.</p>
18	One or more displays read -or	The measurement is out of range. .
19	One or more displays read ---.	The measurement is not available due to lack of probe or it is not programmed.
20	One or more displays read Out.	The internal temperature range for proper analyzer function has reached the allowed minimum or maximum.
21	The display readings quiver.	Outside interference has generated an alarm in the display. Switch off the analyzer, then switch in back on to cancel this effect. (Make sure that the RPM probe wire does not cause interference).
22	The RPM displays gives discontinuous readings.	<p>Make sure that the RPM clamp is firmly closed and that there is no interference from nearby cables. Make sure there are no breaks on the spark plug cable and that it is not excessively shielded. Take appropriate measures if necessary. (Some models of Infragas have a variable external damper to compensate for strong signals, use it if necessary).</p> <p>Make sure that there are no breaks or cracks in the ferrite core of the clamp.</p>

- | | | |
|-----|---|---|
| 23 | There is no reading on the oil temperature display, or the reading is -or or ---. | Oil temperature is only shown when the probe detects temperatures above 45°C. Never put the oil temperature probe in water, it could be irreparably damaged. |
| 24 | The ON (power) led on the keypad is flashing. | The power supply voltage is beyond the range for proper operation. Some programs can print a message such as "Mains voltage out of range" once each time the device is switched on. Take appropriate precautions which may include using a mains voltage stabilizer. |
| 25 | The oxygen display reading remains high while the other gas readings are normal or low. | Check the gas inlet probe from the muffler, there may be breaks in it. Check airtight seals as described in the operator's or service manual. |
| 26 | The PUMP light on the keypad is on, but the reading never changes. | Make sure that the pump is actually aspirating gas. If there is no aspiration the pump may be blocked or the membrane is broken. Replace the pump. |
| 27. | The analyzer cannot connect properly with the PC for service via the serial port. | <p>Make sure that the serial cable connecting the PC and the analyzer is properly inserted.</p> <p>Makes sure you have the A291 disk or program and the File for the analyzer available.</p> <p>Make sure that the dialogue was properly set with the F6 function key: COM1 or COM2 according what is available and what you are connected with on the PC, make sure that the other parameters are 1200, 8, NONE.</p> <p>Return to the A291 menu and selected "Current Analyzer Date & Time Display" the analyzer should respond on the PC monitor and indicate time and date. If this does not happen, carefully recheck the serial cable, PC port and settings.</p> |
| 28 | The service PC cannot find the analyzer file. | <p>Find the disk for the analyzer you are checking. You can identify it by the analyzer serial number (in models only by the last 4 digits).</p> <p>If you are working with the PC using the C drive, copy File Aaxxxxxx . 291" into</p> |

- | | | |
|-----|--|---|
| | | the appropriate directory from the disk the one that comes with the analyzer. |
| 29 | The analyzer carries out unexpected electric calibrations. | There are probably voltage changes on the 220 Vac power supply.
The printed message (on some versions of the program) could show whether the problem is due to mains voltage or frequency. |
| 30. | During measurements the analyzer periodically carries out "cal" electric calibrations even though they were not requested. | Operation should be considered normal. The analyzer carries out periodic "Cal" calibrations from the program when it detects gas in the chamber, it can also carry out other unexpected calibrations when it detects that some parameters do not fall within its correct measuring logic. |
| 31 | The printed report contains a white (unprinted) vertical strip. | This is due to a fault in the print mechanism which is irreparably damaged. Contact the technical service department to have the printer replaced. |
| 32 | After a "CAL" phase the HC display shows a value above 20 ppm. | Leave the pump on, with the gas probe in free air. The gas probe and filters could be contaminated by previous vehicles with high HC values. |
| 33 | The analyzer does not pass the airtight test. | See "Airtight Test" chapter in the operator's manual. |

9 RESIDUAL HC TEST

The instrument does not have an automatic device for residual HC readings and function inhibition in the event that HC values exceed 20 ppm. Therefore, this must be done by the operator.

Method:

Disconnect the gas probe from the vehicle being tested. Now have the analyzer carry out a calibration or auto-clear by pressing the MEAS key. After the "CAL" phase the CO, CO₂ and HC displays should go down to zero relatively quickly.

The CO and CO₂ readings will certainly drop down rapidly, but the HC display could remain above 20 ppm especially if vehicles particularly rich in HC had been tested earlier.

Eliminating Residual HC

If residual HC exceeds ppm, leave the analyzer with the pump on and with the gas probe in air until the HC readings go below the required level.

Persistent HC Residues:

If, even after the above procedure and reasonable pumping time, HC readings remain high, some parts of the gas probe or condensate filter will have to be cleaned. Disconnect the tube from the probe. To clean the condensate filter switch off the analyzer and see the chapter WARNINGS AND PRECAUTIONS in this manual).

Remember to replace the corpuscular filter at the input to the gas probe periodically, as a large amount of oil and contaminant deposits form on it. And this could be the cause of very high HC residues.

10 AIRTIGHT SEAL TEST

To carry out the seal test, proceed as follows:

After carrying out a calibration, and with the pump on, place the specific cap for this test (supplied with the analyzer) on the tip of the gas probe (or close off the holes on the end of the gas probe if you do not have the cap). as soon as the cap is on, the analyzer should realized that cannot draw in gas and the FUNCTION display will read "Err1". If this appears, the seal test has been successfully passed.

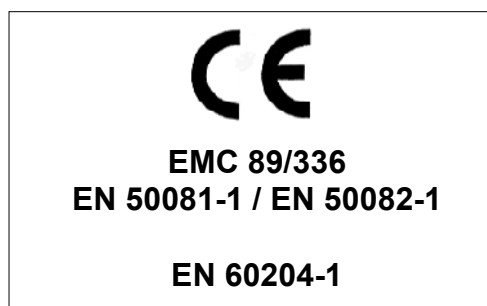
If the analyzer does not have the required seal, no "Err1" reading will appear and you will have to investigate to find out what is wrong. Normally the problem is due to some breakage on the uptake probe or on the rubber tube leading to the analyzer.

If you cannot remedy this fault, contact an authorized service center for advice and/or spare parts to eliminate the problem.

COPYRIGHT
by

ASSEMBLAD S.r.l.
via Marzabotto, 4
50013 Campi Bisenzio (Florence) ITALY
Tel. 055 / 890485 Fax 055 / 890496

Reproduction and/or disclosure prohibited
Release: May 1998



e



sono marchi registrati

Service = pc-c:\winword\dm94\291\R291gb12.doc
Operating = pc-c:\winword\dm94\291\M291gb12.doc